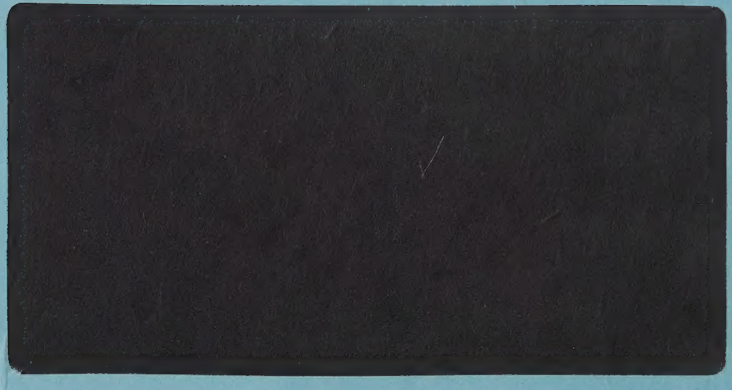
INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

LNS-X SERIES

LAMBDA

LAMBDA ELECTRONICS MELVILLE, L. I., N. Y.



INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

LNS-X SERIES

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to all LNS-X models unless otherwise specified.

LAMBDA ELECTRONICS MELVILLE, L.I., N.Y.

MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

IM-LNS-X

TABLE OF CONTENTS

Section	Page
SPECIFICATIONS AND FEATURES	1
THEORY OF OPERATION	3
OPERATING INSTRUCTIONS	4
Basic Mode of Operation	4
Connections for Operation	4
Supply Load Connections	4
Operation After Protective Device Shutdown	5
MAINTENANCE	6
General	6
Trouble Analysis	6
Checking Transistors and Capacitors	6
Printed Circuit Board Maintenance Techniques	6
Trouble Chart	7
Performance Checks	8
Adjustment of Calibration Control R4	9
SERVICE	10
PARTS ORDERING	10

SPECIFICATIONS AND FEATURES

D. C. OUTPUT — Voltage regulated for line and load. See table I for voltage and current ratings.

TABLE I

MODELS	VOLTAGE RANGE	MAXIMUM CURRENT (AMPS)* AT AMBIENT TEMPERATURE				INPUT POWER (WATTS)**
		40°C	50°C	60°C	71°C	
LNS-X-5-OV	5 ±5%	10.0	8.9	7.3	5.3	180
LNS-X-6	6 ±5%	9.5	8.4	7.1	5.0	180
LNS-X-12	12 ±5%	6.5	5.5	4.5	3.3	200
LNS-X-15	15 ±5%	5.5	4.8	3.9	2.8	200
LNS-X-20	20 ±5%	4.4	3.6	2.6	1.6	200
LNS-X-24	24 ±5%	3.8	3.2	2.4	1.4	200
LNS-X-28	28 ±5%	3.4	2.9	2.2	1.2	200

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range.

*Ratings apply for use with cover removed. Derate current 15% for each ambient temperature if cover is used. **Refer to figure 11 for cover removal.**

**With output loaded to full current rating and input voltage 127 volts AC, 60 Hz.

REGULATED VOLTAGE OUTPUT

Regulation (line) . . . . . 0.1% for input variations from 105-127, 127-105, 210-254, or 254-210 volts AC.

Regulation (load) . . . . . 0.1% for load variations from no load to full load or full load to no load.

Ripple and Noise . . . . . 1.5mV rms, 5mV peak to peak with either positive or negative terminal grounded.

Temperature Coefficient. . . . . Output change in voltage 0.03%/°C.

Remote Programming

External Resistor . . . . . Nominal 200 ohms/volt output.

Programming Voltage. . . . . One-to-one voltage change.

Remote Sensing . . . . . Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

OVERSHOOT — No overshoot under conditions of power turn-on, turn-off, or power failure.

AC INPUT — 105-127 or 210-254* volts AC at 47-440 Hz. Standard LNS-X power supplies are factory wired for 105-127 volt input, but can be rewired for 210-254 volt input. See figure 8 and schematic diagram for rewiring of AC input. For input power see table I. Ratings apply for 57-63 Hz input. For 47-53 Hz or 63-440 Hz input consult factory.

*Certified by Canadian Standards Association for 210-250 volt input.

OVERLOAD PROTECTION

Thermal	Thermostat, resets automatically when over temperature condition is eliminated.
Electrical	Automatic electronic current limiting circuit, limits output current to a safe value. Automatic current limiting protects the load and power supply when external overloads and direct shorts occur.

OVERVOLTAGE PROTECTION — Model LNS-X-5-OV includes a fixed built-in overvoltage protection circuit which prevents damage to the load caused by excessive power supply output voltage. Overvoltage protection range varies between 6.4 and 6.8 volts D.C.

INPUT AND OUTPUT CONNECTIONS — Refer to figure 11 for location.

AC input	Screw terminals on printed circuit board
Ground	Terminal on transformer
DC output	Screw terminals on printed circuit board
Sensing	Screw terminals on printed circuit board
Overvoltage protection	Quick disconnect terminals on printed circuit board with mating connectors attached.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from 0°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE (non operating) — -55°C to +85°C

FUNGUS — All LNS-X power supplies are fungus inert.

DC OUTPUT CONTROL — Screwdriver voltage adjust control permits adjustment of DC output voltage. Refer to figure 11 for location of control.

PHYSICAL DATA

Size	7" x 4-7/8" x 2-7/8" with cover in place 7" x 4-7/8" x 2-3/4" with cover removed
Weight	7-3/4 lbs. net; 8-1/4 lbs. shipping
Finish	Gray, FED. STD. 595 No. 26081

MOUNTING — Three surfaces, two with tapped mounting holdes and one with clearance mounting holes, can be utilized for mounting this unit. Air circulation is required when unit is mounted in confined areas. Refer to figure 11 for mounting details.

"J" OPTION — All LNS-X power supplies can be obtained for 90-110 VAC, 47-440 Hz input. Ratings apply for 57-63 Hz input. For 47-53 Hz or 63-440 Hz input consult factory.

ACCESSORIES

Overvoltage Protector	Internally mounted L-12-OV series Overvoltage Protectors are available.

THEORY OF OPERATION

GENERAL

The Lambda power supply consists of an AC input circuit and transformer; a bias supply consisting of an auxiliary rectifier and filter, and pre-regulator; a main regulator circuit consisting of the main rectifier and and filter, a series regulator, voltage sensing network, current sensing resistor, voltage reference*, voltage and current comparators*, and amplifier*.

*This circuit element is part of integrated circuit (IC1) in the supply.

The circuit arrangement is shown in block diagram form, Figure 9. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Single phase input power is applied to transformer T1 through the input circuit which contains a thermostat to protect the supply against over heating.

The main rectifier, a full wave rectifier, provides the power which is filtered by capacitor C1 and then regulated via a series regulator and delivered to the output. Half-wave auxiliary rectifier CR3 provides voltage filtered by capacitor C2 for the preregulator CR4. The reference element, powered by the preregulator, provides a reference voltage for the voltage comparator.

Constant voltage circuit operation is determined by changes in line or load which cause a change in one input to the voltage comparator through voltage dividers R9, R10, and R6. A second input to the comparator is a reference voltage developed in IC1. The comparator compares the output voltage change with the reference voltage resulting in an error signal at the output of the comparator.

The error signal from the comparator controls the voltage across series regulators Q1 and Q2, which function as the active regulating elements in the supply.

Current limit circuit operation is determined by changes in the load. The current comparator samples load current through current sensing resistors R7, R8. When the voltage drop across R7, R8 increases to a pre-set voltage reference determined by R11, R12, R4, and R5, the current comparator conducts. Thus, when the output current rating of the unit is exceeded, the current comparator conducts, decreasing the drive to Q1, Q2; resulting in an increase of voltage across the series regulator and a decrease of the output voltage, effectively limiting the output current to a safe value. The current limit value is determined by fixed resistors R7, R8, R11, R12, R5, and variable resistor R4.

When operating conditions approach short circuit, the output voltage decreases. Since the voltage determined by R4 is proportional to the output voltage, when the output voltage decreases, the amplifier is biased into turn on at lower and lower load currents until output voltage decreases to zero and current decreases to a predetermined low value.

OV CIRCUIT, FUNCTIONAL DESCRIPTION (LNS-X-5-OV only)

When the power supply output voltage increases above the overvoltage limit (6.4 to 6.8 volts), HC1 fires causing the power supply output voltage to drop.

OPERATING INSTRUCTIONS

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40° C. For continuous operation, load current must not exceed the rating for each ambient temperature. When load exceeds 130% of 40° C rating, both voltage and current decrease until voltage reaches zero and the current at short circuit equals approximately 40 percent or less of the rated current.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying AC input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminals provided. Apply input power to AC terminals; always connect the ungrounded (hot) lead to terminal indicated in figures 3 through 7.

The supply positive terminal is brought out to terminal +V. The supply negative terminal is brought out to terminal -V. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 7. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections for Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for applications with relatively constant load or for applications with short power output leads.

Remote Sensing Connection, Figure 4. Remote sensing provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5 mf, elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at 200 ohms/volt change and shorting-type switch as shown in Figure 5. When continuous voltage variations are required, use a variable resistor with the same 200 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation.

Before programming, adjust programming resistor for zero resistance and set voltage adjust control to the minimum rated output voltage. Output voltage of programmed supply will be minimum output voltage plus 1 volt per 200 ohms.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage change of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply. If the output voltage control of the programmed supply is set to minimum output voltage, output voltage of programmed supply will be minimum output voltage plus voltage of programming supply.

The programming supply must have a reverse current capability of 6 ma. minimum.

Alternatively, when supplies with less than 6 ma. reverse current capability are used, a resistor capable of drawing 6 ma. at the minimum programming voltage must be connected across the output terminals of the supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections For Series Operation, Figure 7.

The voltage capability of LNS-X power supplies can be extended by series operation. Figure 7 shows the connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output.

A diode, having a current carrying capability equal to or greater than the maximum current rating of the supply, must be used and connected as shown in figure 7. The diode blocking voltage should be at least twice the maximum rated output voltage of the supply. See table I, of "Specifications and Features", for power supply current and voltage ratings.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown

The thermostat opens the input circuit only when the temperature of the internal heat sink exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value. After eliminating the cause(s) for overheating and allowing time for the power supply to cool to a proper temperature, resume operation of the supply.

Overvoltage Shutdown (LNS-X-5-OV only)

When the power supply output voltage increases above the overvoltage limit, HC1 will short circuit output of the supply. After eliminating the cause(s) for overvoltage, resume operation of the supply by momentarily interrupting the AC input circuit. (Refer to Trouble Shooting Chart.)

GENERAL

This section describes trouble analysis routine, replacement procedures, calibration and test procedures that are useful for servicing the Lambda LNS-X power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on specifications and features for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check fuse, primary power lines, external circuit elements, and external wiring for malfunction before trouble shooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumper and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 9, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an instrument that has a highly limited current capability. Observe proper polarity to avoid error in measurement. The forward transistor resistance is low but never zero; backward resistance is always higher than the forward resistance.

For good transistors, the forward resistance for any junction is always greater than zero.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional defective components could damage the replaced component.

When soldering semi-conductor devices, wherever possible, hold the lead being soldered with a pair of pliers placed between the component and the solder joint to provide an effective heat sink.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not covered with solder, it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needlepoint probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to the measuring instrument.

3. Wherever possible use a heat sink when soldering transistors.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:

a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

b) Dip the wick in liquid rosin flux.

c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes, and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

a) AC power of proper voltage and frequency is present at input terminals.

b) Either positive or negative terminal is connected to chassis ground.

c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

TROUBLE SHOOTING CHART

Symptom	Possible Cause	Remedy
1. Zero volts DC output	Short circuit across output of supply	Check load and load connections correct as necessary
	Series regulator section open	Check Q1, and Q2 for open, replace as necessary
	Current sensing resistors open	Check R7 and R8 for open
	Aux. rectifier CR3 open	Check CR3 for open; replace as necessary
	IC1 defective	Voltage at pin 6 must measure above rated output voltage. If reading exceeds nominal voltage rating by 3 volts or if less than rated output voltage, replace IC1

TROUBLE SHOOTING CHART (Cont)

Symptom	Possible Cause	Remedy
2. Unable to adjust output voltage	Damaged VDC ADJ. control	Check R10 for short or open, replace as necessary
3. High ripple at line frequency or twice line frequency and unregulated DC output	Series regulator transistors shorted	Check and replace as necessary: Q1, Q2.
	Defective main rectifier causes ripple at twice line frequency	Check for open or short CR1A, CR1B, CR2A, and CR2B.
4. Same as 3, except intermittent	Foreign matter fallen into unit	Check for loose bench hardware and wire clippings that may have fallen through cover
5. High ripple at frequency other than line or twice line frequency	Oscillation due to defective component in filter network	Check for open C8, C4, and check for open or short in C3 and R16. Replace defective component
6. Large spikes at output	Capacitors C5, C6 or, as applicable, C7 open.	Replace as necessary
7. Output voltage too high	R10 set too high; shorted Q1, Q2; open sensing lead, defective IC1	Check setting of R10; check Q1, Q2; replace as required; see Symptom 1 for "defective IC1"
8. Very low output voltage on model LNS-X-5-OV	HC1 fired due to OV condition	Momentarily interrupt AC input. If supply operates normally, a transient has occured in line or load, check wiring (switches, etc) If supply fails to reach full output voltage, remove AC input, disconnect +V pin of HC1, remove load, apply AC power and refer to procedure for: Output voltage too high "Symptom 7"

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 10. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC DVM (John Fluke Model 891A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the load to no-load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-127 or 127-105 volts AC and check the power supply line regulation accuracy on the DVM differential meter.

Use a TVM, John Fluke Model 931B or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CALIBRATION CONTROL R4

Whenever Q1, Q2, R7, R8, R4, R5, or IC1 are replaced, and voltage and current indications do not reflect maximum ratings, adjust R4 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C, and is stabilized and not operating.

1. Remove AC input power to the supply.

2. Break seal on wiper of R4 from resistor housing and turn to full CW position.

3. Operate power supply for constant voltage with local sensing, connected as shown in figure 3, with no external load.

4. Turn voltage adjust control until minimum rated output voltage is obtained.

5. Apply load so that output current is 130% of 40°C rating for the unit.

6. Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R4 in CCW direction. Adjust R4 until output ripple begins to increase.

7. Turn voltage adjust control until maximum rated output voltage is obtained.

8. Increase load. Maximum attainable load current shall not exceed 150% of 40°C rating for the unit.

9. After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R4 to resistor housing.

10. After sealing, check setting and repeat adjustment procedure if required.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standrad Components and special components used the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.
2. Lambda part number.
3. Description of part together with circuit designation.
4. If part is not an electronic part, or is not listed, provide a description, function, and location, of the part.

PARTS LIST

The electrical parts located on Lambda models LNS-X-5-OV — LNS-X-28 are listed here. Parts common to a group of models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group common parts listing. In addition there is a separate listing of parts for the "J" option.

COMMON PARTS
MODELS LNS-X-5-OV AND LNS-X-6

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1	Cap., elect., 28,500 mf -10 +100%, 15 vdc	CBT-29-062
C2	Cap., elect., 90 mf -10 +100%, 40 vdc	CBP-90-104
C3	Cap., ceramic, 0.001 mf ±20%, 1,000 vdc	CDK-10-010
C4	Cap., elect., 1,000 mf -10 +100%, 15 vdc	CBS-10-154
C5, C6	Cap., mylar, 0.022 mf ±10%, 200 vdc	CGL-22-001
C7	Not assigned	
C8	Cap., elect., 1 mf ±20%, 35 vdc	CBN-10-009
CR1	Rectifier, dual	FBL-00-139
CR2	Not assigned	
CR3	Rectifier	FBL-00-030
CR4	Rectifier, zener diode	FBM-Z155
CR5	Same as CR3	
IC1	Integrated circuit	FBT-00-073
Q1, Q2	Transistor, NPN	FBN-L169
R2	Res., comp., 560 ohms ±10%, ½ w	DEB-5611
R3	Not assigned	
R4	Res., var., cermet, 100 ohms ±20%, 1 w	DRR-10-010
R6	Res., film, 499 ohms ±1%, ½ w	DCR-50-029
R7, R8	Res., ww, 0.1 ohm ±5%, 5 w	DFM-10-074
R10	Res., var., cermet, 400 ohms ±10%, 1 w	DRR-40-013
R11, R12	Res., comp., 100 ohms ±10%, ½ w	DEB-1011
R13, R14	Res., comp., 27 ohms ±5%, ½ w	DEB-2705
R15	Not assigned	
R16	Res., comp., 10 ohms ±10%, ½ w	DEB-1001
S1	Thermostat	FKA-137-014

UNIQUE PARTS
MODEL LNS-X-5-OV

HC1	Hybrid circuit	L-12-OV-5
R1	Res., ww, 750 ohms ±3%, 3 w	DFR-75-085
R5	Res., comp., 750 ohms ±5%, ½ w	DEB-7515
R9	Res., film, 392 ohms ±1%, ½ w	DCR-39-098
T1	Transformer	ABA-LNSX-5

UNIQUE PARTS (Cont.)
MODEL LNS-X-6

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R1	Res., ww, 910 ohms ±3%, 3 w	DFR-91-069
R5	Res., comp., 1,000 ohms ±5%, ½ w	DEB-1025
R9	Res., film, 562 ohms ±1%, ½ w	DCR-56-099
T1	Transformer	ABA-LNSX-6

COMMON PARTS
MODELS LNS-X-12 AND LNS-X-15

C1	Cap., elect., 14,500 mf -10 +100%, 30 vdc	CBT-15-063
C2	Cap., elect., 90 mf -10 +100%, 40 vdc	CBP-90-104
C3	Cap., ceramic, 0.001 mf ±20%, 1,000 vdc	CDK-10-010
C4	Cap., elect., 580 mf -10 +100%, 30 vdc	CBR-58-158
C5, C6	Not assigned	
C7	Cap., mylar, 0.022 mf ±10%, 200 vdc	CGL-22-001
C8	Cap., elect., 1 mf ±20%, 35 vdc	CBN-10-009
CR1	Rectifier, dual	FBL-00-139
CR2	Rectifier, dual	FBL-00-141
CR3, CR5	Rectifier	FBL-00-030
IC1	Integrated circuit	FBT-00-073
Q1, Q2	Transistor, NPN	FBN-L169
R2	Res., comp., 560 ohms ±10%, ½ w	DEB-5611
R3	Not assigned	
R4	Res., var., cermet, 100 ohms ±20%, 1 w	DRR-10-010
R6	Res., film, 499 ohms ±1%, ½ w	DCR-50-029
R7, R8	Res., ww, 0.125 ohms ±5%, 3 w	DFM-13-036
R10	Res., var., cermet, 800 ohms ±10%, 1 w	DRR-80-014
R11, R12	Res., comp., 100 ohms ±10%, ½ w	DEB-1011
R13, R14	Res., comp., 27 ohms ±5%, ½ w	DEB-2705
R15	Not assigned	
R16	Res., comp., 10 ohms ±10%, ½ w	DEB-1001
S1	Thermostat	FKA-137-014

UNIQUE PARTS
MODEL LNS-X-12

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
CR4	Rectifier, zener diode	FBM-Z161
R1	Res., ww, 1,200 ohms ±2%, 3 w	DFS-12-016
R5	Res., comp., 2,200 ohms ±5%, ½ w	DEB-2225
R9	Res., film, 1,620 ohms ±1%, ½ w	DCS-16-113
T1	Transformer	ABA-LNSX-12

MODEL LNS-X-15

CR4	Rectifier, zener diode	FBM-Z161
R1	Res., ww, 1,500 ohms ±3%, 3 w	DFS-15-045
R5	Res., comp., 2,700 ohms ±10%, ½ w	DEB-2721
R9	Res., film, 2,150 ohms ±1%, ½ w	DCS-22-114
T1	Transformer	ABA-LNSX-15

COMMON PARTS
MODELS LNS-X-20 — LNS-X-28

C1	Cap., elect., 12,500 mf -10 +100%, 50 vdc	CBT-13-039
C2	Cap., elect., 90 mf -10 +100%, 40 vdc	CBP-90-104
C3	Cap., ceramic, 0.001 mf ±20%, 1,000 vdc	CDK-10-010
C4	Cap., elect., 310 mf -10 +100%, 50 vdc	CBR-31-157
C5, C6	Not assigned	
C7	Cap., mylar, 0.022 mf ±10%, 200 vdc	CGL-22-001
C8	Cap., elect., 1.5 mf ±20%, 50 vdc	CBN-15-032
CR1	Rectifier, dual	FBL-00-142
CR2	Rectifier, dual	FBL-00-143
CR3, CR5	Rectifier	FBL-00-030
IC1	Integrated circuit	FBT-00-073
Q1, Q2	Transistor, NPN	FBN-L170
R3	Not assigned	
R4	Res., var., cermet, 100 ohms ±20%, 1 w	DRR-10-010
R6	Res., film, 499 ohms ±1%, ½ w	DCR-50-029
R7, R8	Res., ww, 0.208 ohm ±5%, 3 w	DFM-21-030
R11, R12	Res., comp., 100 ohms ±10%, ½ w	DEB-1011
R13, R14	Res., comp., 27 ohms ±5%, ½ w	DEB-2705
R16	Res., comp., 10 ohms ±10%, ½ w	DEB-1001
S1	Thermostat	FKA-137-014

UNIQUE PARTS
MODEL LNS-X-20

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
CR4	Rectifier, zener diode	FBM-Z127
R1	Res., ww, 2,000 ohms ±3%, 3 w	DFS-20-032
R2	Res., comp., 560 ohms ±10%, ½ w	DEB-5611
R5	Res., comp., 3,300 ohms ±5%, ½ w	DEB-3325
R9	Res., film, 3,010 ohms ±1%, ½ w	DCS-30-115
R10	Res., var., cermet, 1,400 ohms ±10%, 1 w	DRS-14-025
R15	Res., comp., 3,300 ohms ±10%, 2 w	DHB-3321
T1	Transformer	ABA-LNSX-20

MODEL LNS-X-24

CR4	Rectifier, zener diode	FBM-Z144
R1	Res., ww, 2,500 ohms ±3%, 3 w	DFS-25-036
R2	Res., comp., 750 ohms ±5%, ½ w	DEB-7515
R5	Res., comp., 4,300 ohms ±5%, ½ w	DEB-4325
R9	Res., film, 3,740 ohms ±1%, ½ w	DCS-37-116
R10	Res., var., cermet, 1,400 ohms ±10%, 1 w	DRS-14-025
R15	Res., comp., 3,300 ohms ±10%, 2 w	DHB-3321
T1	Transformer	ABA-LNSX-24

MODEL LNS-X-28

CR4	Rectifier, zener diode	FBM-Z144
R1	Res., ww, 2,500 ohms ±3%, 3 w	DFS-25-036
R2	Res., comp., 750 ohms ±5%, ½ w	DEB-7515
R5	Res., comp., 5,600 ohms ±10%, ½ w	DEB-5621
R9	Res., film, 4,420 ohms ±1%, ½ w	DCS-44-117
R10	Res., var., cermet, 1,600 ohms ±10%, 1 w	DRS-16-026
R15	Res., comp., 4,700 ohms ±10%, 2 w	DHB-4721
T1	Transformer	ABA-LNSX-28

PARTS FOR "J" OPTION

On all LNS-X models with suffix "J", transformer T1 changes. For transformer T1 used on these models, see standard LNS-X model parts list for the standard transformer part no. and add suffix "J" to the part no.

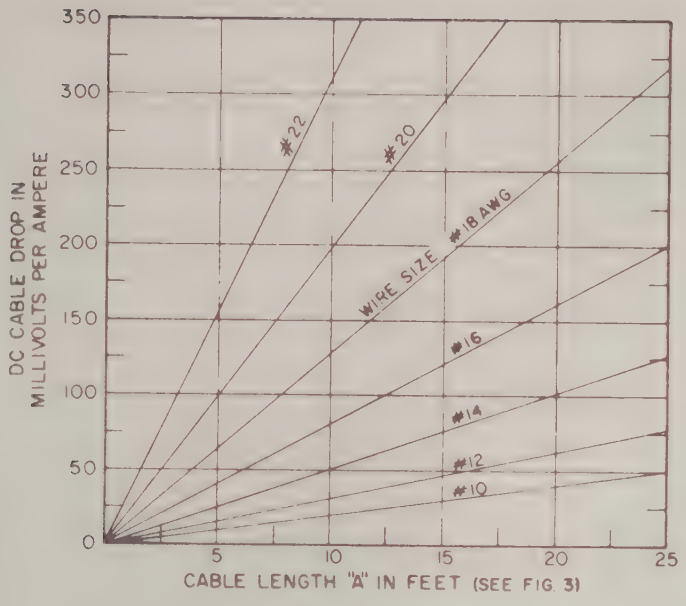


Figure 1. Cable Connection Chart.

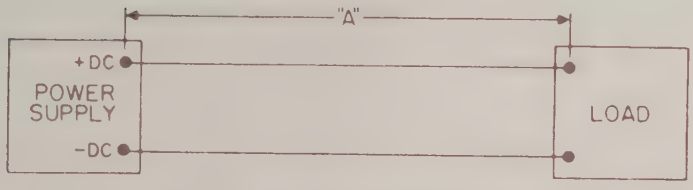
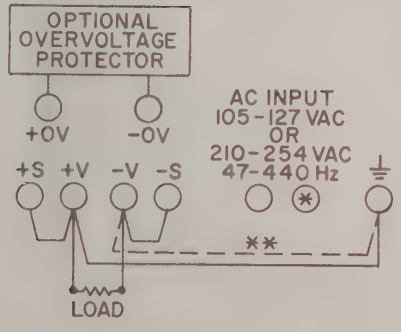


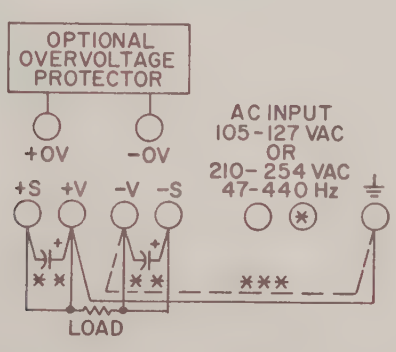
Figure 2. Cable Length "A" in Feet.



* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL

** FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS −V & ⏚.

Figure 3. Local Sensing Connection.



* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL

** A 2.5MF, ELECT., CAP. MAY BE REQUIRED

*** FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS −V & ⏚.

Figure 4. Remote Sensing Connection.

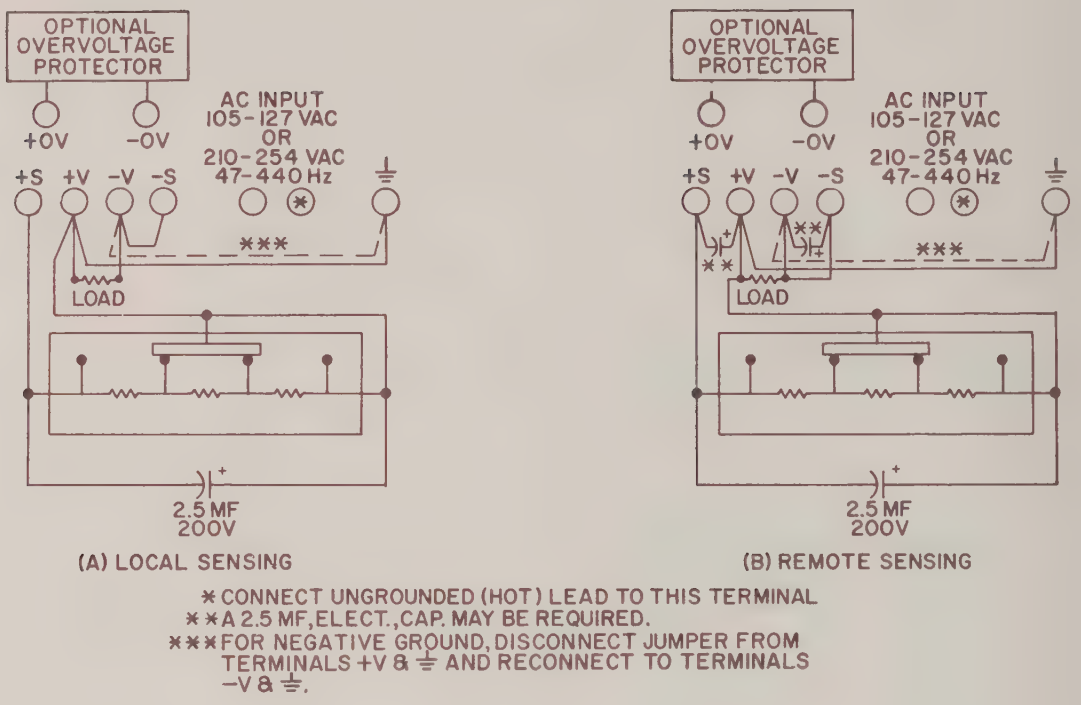

OPTIONAL OVERVOLTAGE PROTECTOR
+OV
-OV
AC INPUT 105-127 VAC OR 210-254 VAC 47-440 Hz
+S +V -V -S
***
LOAD
2.5 MF 200V
(A) LOCAL SENSING
(B) REMOTE SENSING
* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL
** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.
*** FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS -V & ⏚.

Figure 5. Programmed Voltage, With External Resistor.

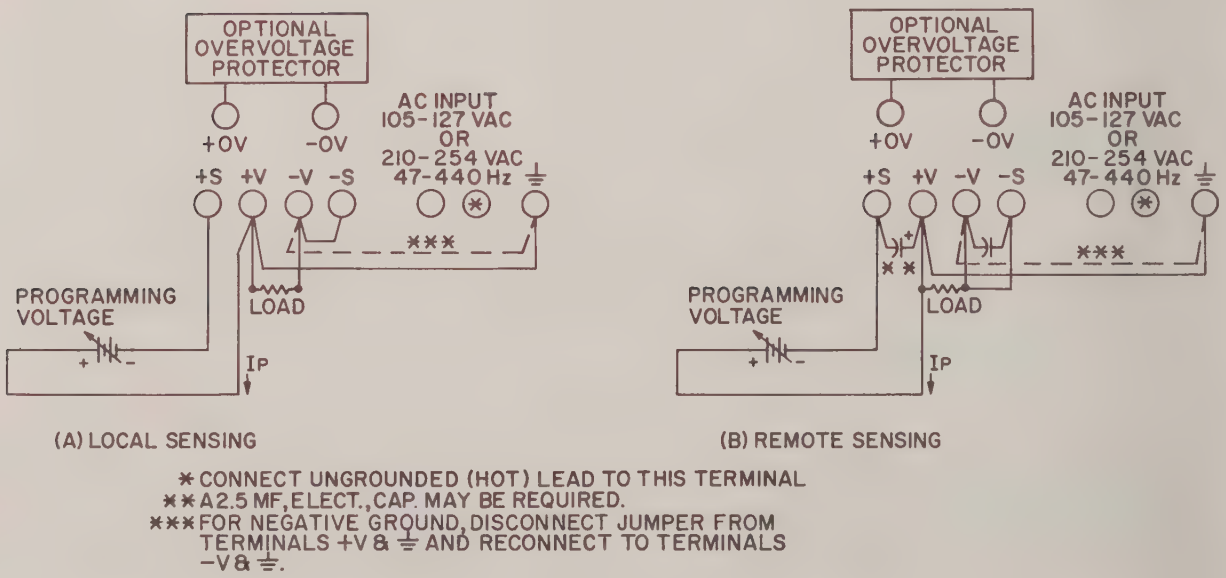
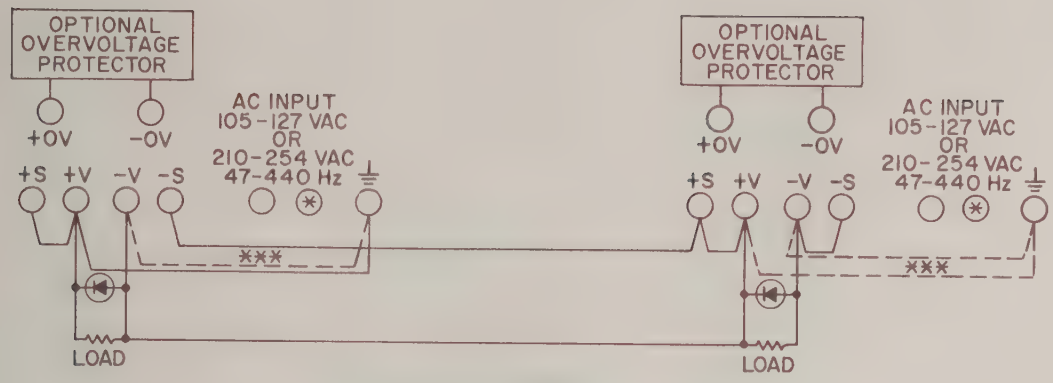
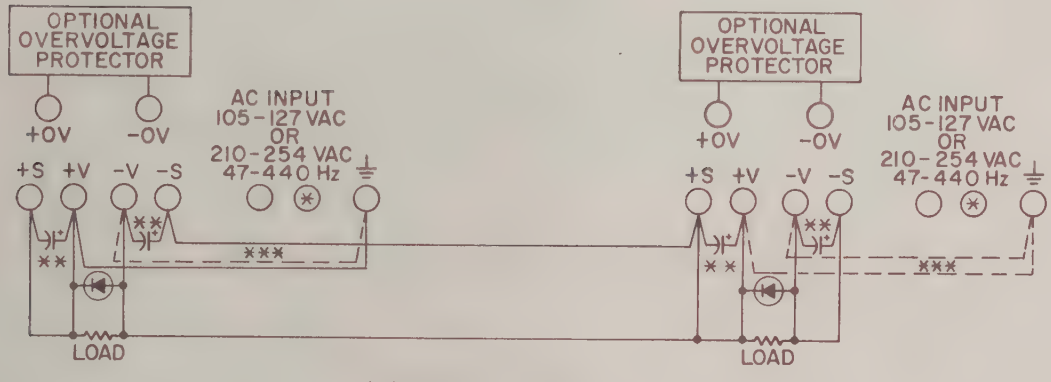

OPTIONAL OVERVOLTAGE PROTECTOR
+OV
-OV
AC INPUT 105-127 VAC OR 210-254 VAC 47-440 Hz
+S +V -V -S
***
LOAD
PROGRAMMING VOLTAGE
IP
(A) LOCAL SENSING
(B) REMOTE SENSING
* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL
** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.
*** FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS -V & ⏚.

Figure 6. Programmed Voltage, With External Programming Voltage Source.



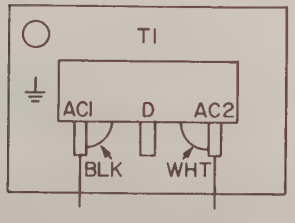
(A) LOCAL SENSING



(B) REMOTE SENSING

* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL.
** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.
*** MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION. TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS +V & ON LEFT UNIT AND CONNECT ANY ONE OF THE JUMPERS SHOWN IN DOTTED LINE.

Figure 7. Series Connection.



CONNECTION SHOWN IS FOR 105-127 VAC. FOR 210-254V INPUT, DISCONNECT BLK & WHT TRANSFORMER LEADS FROM TERMS AC1 & AC2 AND RECONNECT BOTH LEADS TO TERM D.

Figure 8. Transformer Connections for AC Input Conversion.

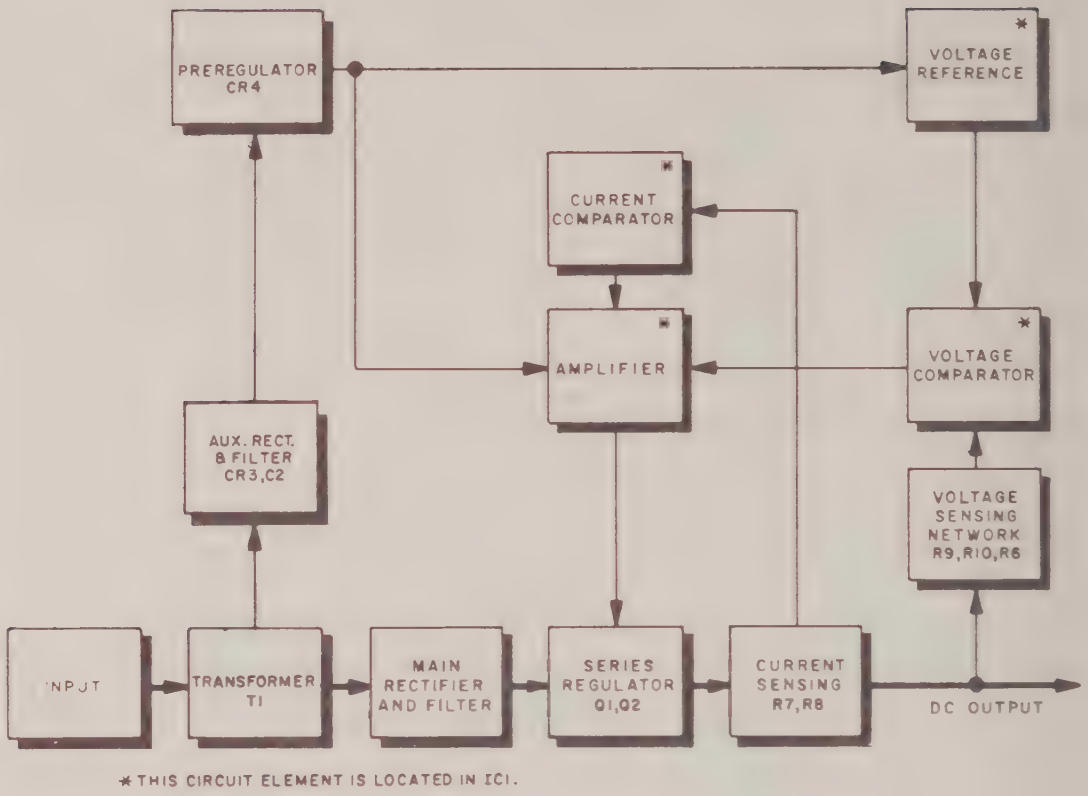
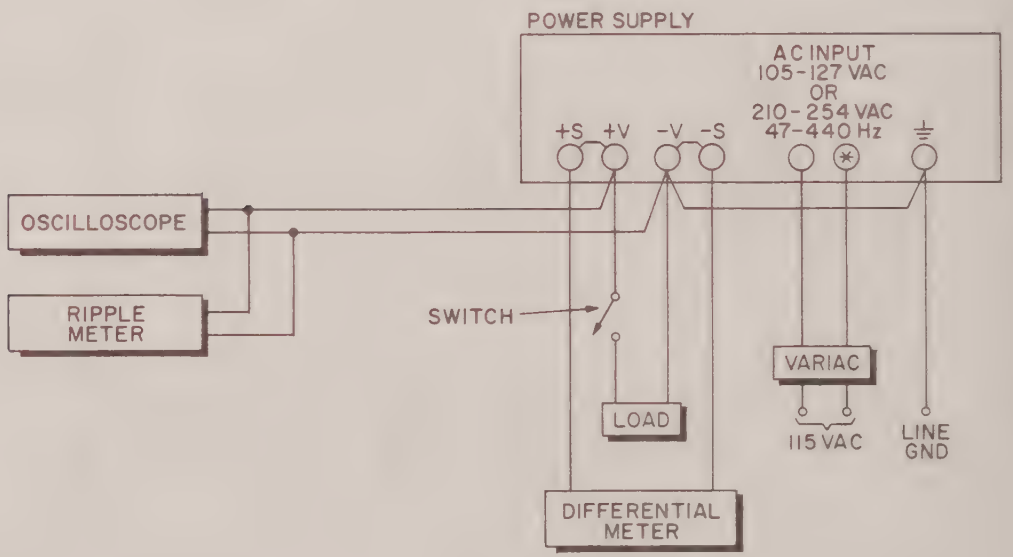


Figure 9. Typical Block Diagram.



* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL

NOTES:
1. REGULATION AND RIPPLE CHECKMETERS MUST NOT BE GROUNDED THROUGH THREE-WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTIONS ONLY.

Figure 10. Test Connections For Constant Voltage Performance Checks.

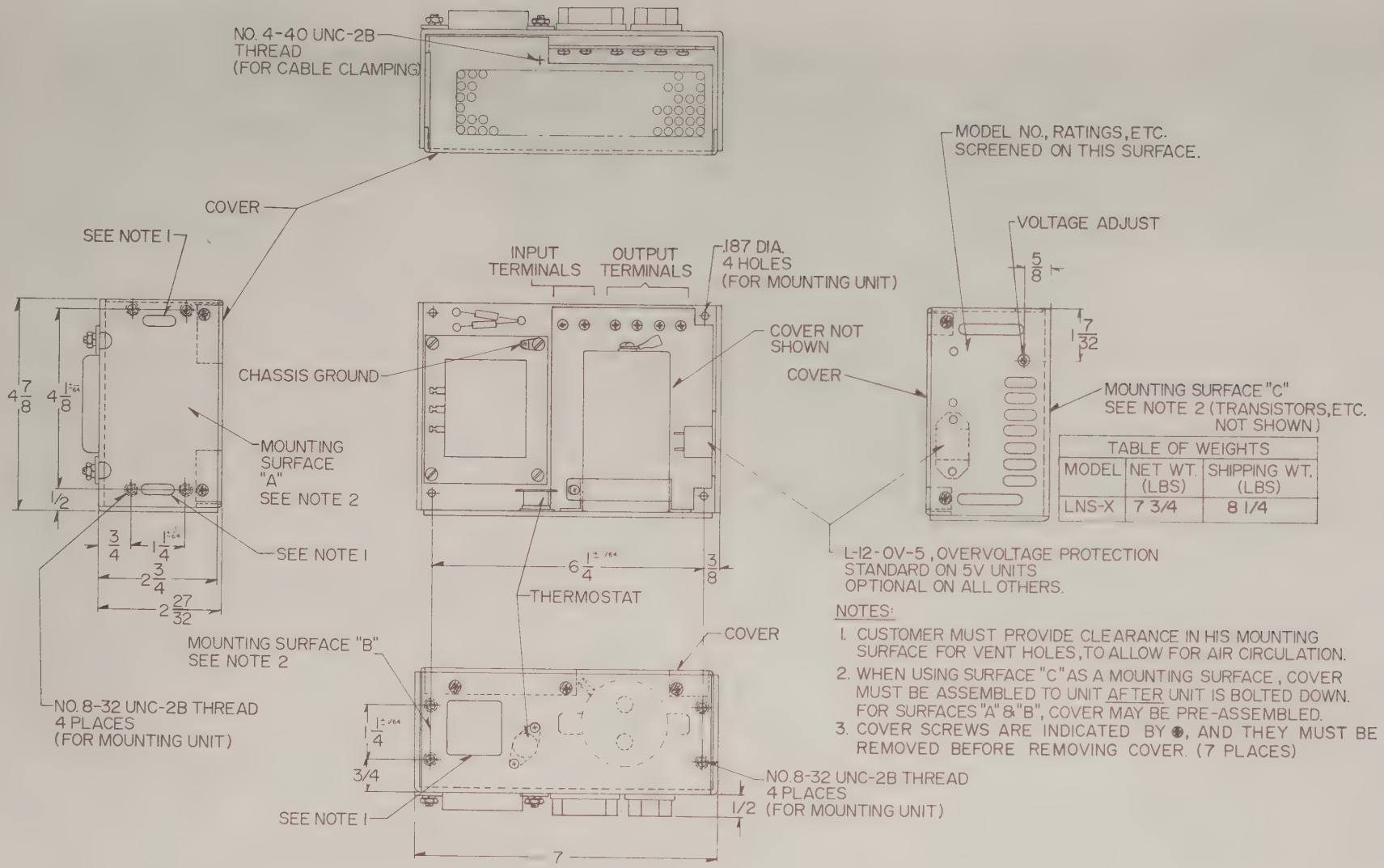
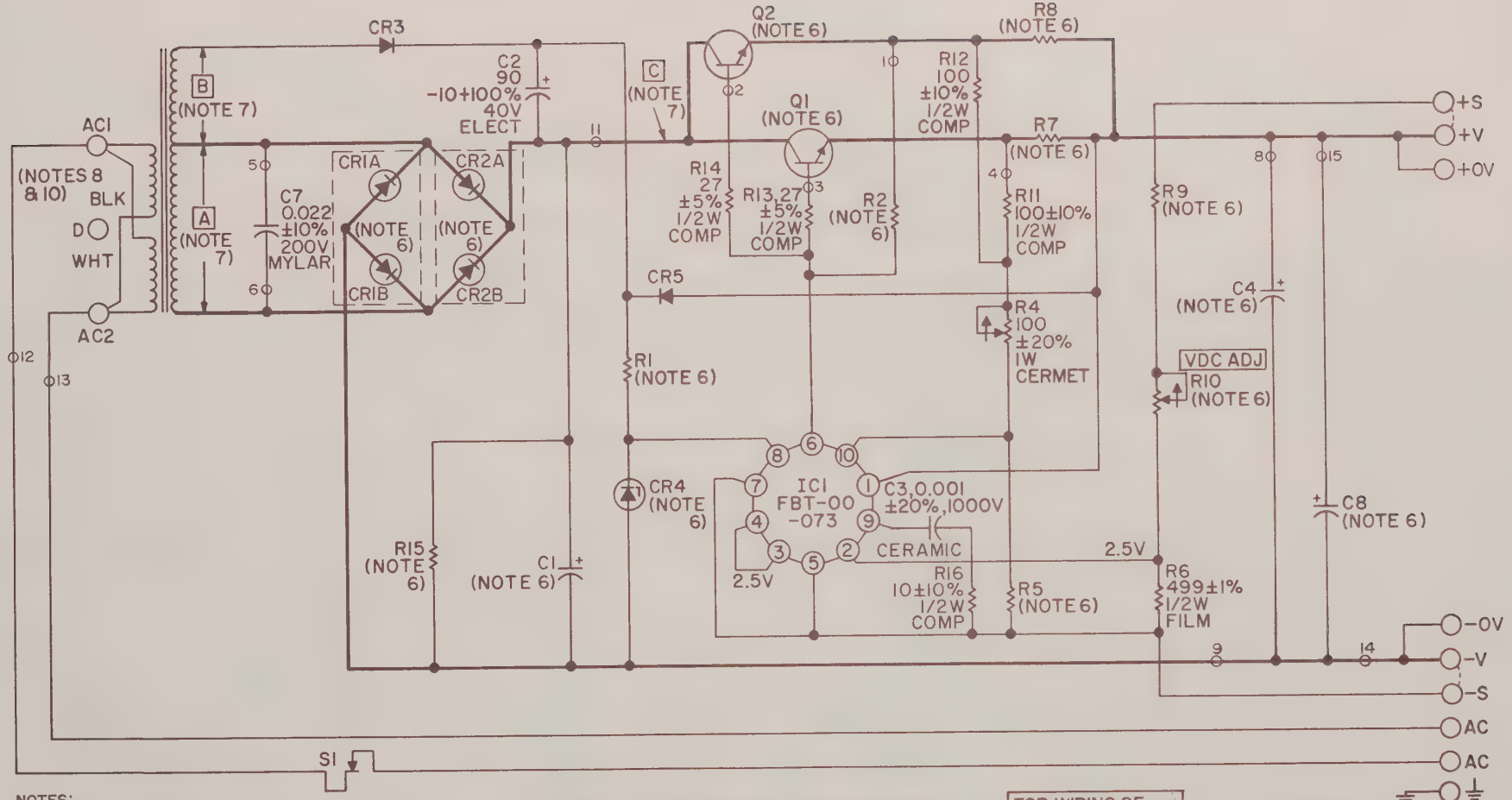


TABLE OF WEIGHTS		
MODEL	NET WT. (LBS)	SHIPPING WT. (LBS)
LNS-X	7 3/4	8 1/4

NOTES:

1. CUSTOMER MUST PROVIDE CLEARANCE IN HIS MOUNTING SURFACE FOR VENT HOLES, TO ALLOW FOR AIR CIRCULATION.
2. WHEN USING SURFACE "C" AS A MOUNTING SURFACE, COVER MUST BE ASSEMBLED TO UNIT AFTER UNIT IS BOLTED DOWN. FOR SURFACES "A" & "B", COVER MAY BE PRE-ASSEMBLED.
3. COVER SCREWS ARE INDICATED BY ●, AND THEY MUST BE REMOVED BEFORE REMOVING COVER. (7 PLACES)

Figure 11. Outline Drawing.



NOTES:

1. RESISTOR VALUES ARE IN OHMS.
2. CAPACITOR VALUES ARE IN MICROFARADS.
3. DESIGNATIONS ARE LAMBDA PART NUMBERS.
4. SYMBOLS
   - ↟ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - ⏚ INDICATES CONNECTION TO CHASSIS.
   - —▶|— LAMBDA PART NO. FBL-00-030; USE IN4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - —o— INDICATES TERMINAL ON PRINTED CIRCUIT BOARD.
   - ▭ INDICATES ACTUAL UNIT MARKING.
5. FOR OPERATION AT 47-53Hz OR 63-440Hz, CONSULT FACTORY.
6. SEE TABLE I FOR COMPONENT VALUES.
7. SEE TABLE I FOR VOLTAGE VALUES.
8. T1 PRIMARY CONNECTION SHOWN IS FOR 105-127VAC INPUT. FOR 210-254 VAC INPUT: DISCONNECT BLK & WHT TRANSFORMER LEADS FROM TERM'S. AC1 & AC2 AND RECONNECT BOTH LEADS TO TERM. D.
9. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115VAC, 60Hz. NOMINAL OUTPUT VOLTAGE, NO LOAD, +S AND +V SHORTED, -S AND -V SHORTED. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN -S AND INDICATED POINTS UNLESS OTHERWISE NOTED.
10. "J" OPTION UNITS HAVE SINGLE T1 PRIMARY. AC INPUT IS 90-110 VAC.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS..

DOTTED CONNECTIONS SHOWN INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

MODELS
LNS-X-12
LNS-X-15
LNS-X-20
LNS-X-24
LNS-X-28

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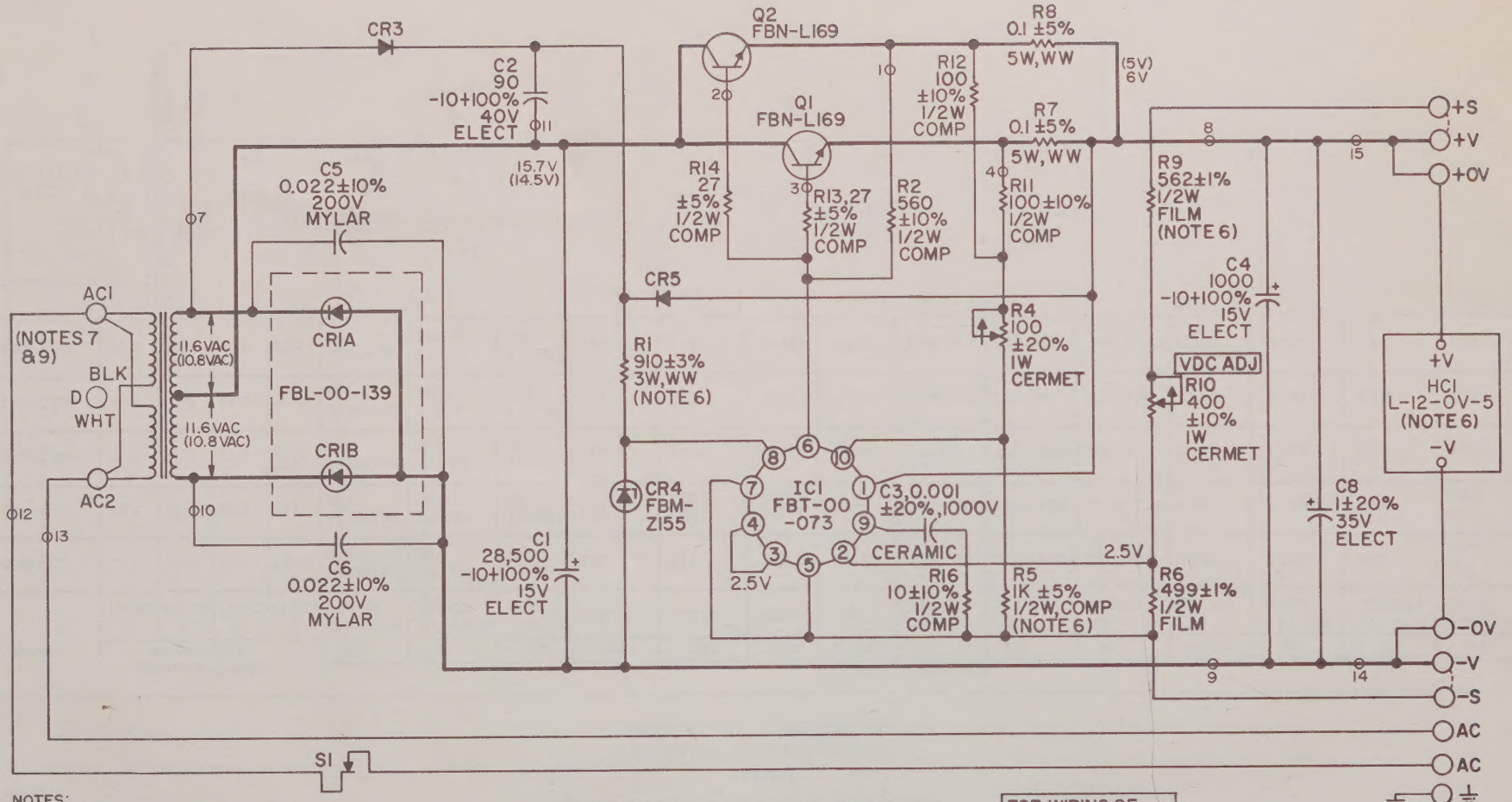
ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.

TABLE I
SCHEMATIC DATA REFERENCES
MODELS LNS-X-12 THRU LNS-X-28

Models	Schematic Voltage Measurements				Schematic Components												
					C1	C4	C8	CR1	CR2	CR4	Q1, Q2	R1	R2	R5	R7, R8	R9	R10	R15
	A (VAC)	B (VAC)	C (VDC)	D (VDC)	-10 +100% ELECT.	-10 +100% ELECT.	±20% ELECT.	FBL-00-*	FBL-00-*	FBM-*	FBN-*	3W WW	½W COMP.	½W COMP.	±5% 3W, WW	±1%, ½W FILM	±10%, 1W CERMET	±10%, 2W COMP.
LNS-X-12	19.0	18.5	25.4	12.0	14,500 mf 30V	580 mf 30V	1.0 mf 35V	139	141	Z161	L169	1.2K ±2%	560 ±10%	2.2K ±5%	0.125	1.62K	800	Not Used
LNS-X-15	22.4	22.4	30.3	15.0	14,500 mf 30V	580 mf 30V	1.0 mf 35V	139	141	Z105	L169	1.5K ±3%	560 ±10%	2.7K ±10%	0.125	2.15K	800	Not Used
LNS-X-20	27.1	27.1	37.0	20.0	12,500 mf 50V	310 mf 50V	1.5 mf 50V	142	143	Z127	L170	2K ±3%	560 ±10%	3.3K ±5%	0.208	3.01K	1.4K	3.3K
LNS-X-24	32.3	32.3	44.3	24.0	12,500 mf 50V	310 mf 50V	1.5 mf 50V	142	143	Z144	L170	2.5K ±3%	750 ±5%	4.3K ±5%	0.208	3.74K	1.4K	3.3K
LNS-X-28	36.2	29.7	49.8	28.0	12,500 mf 50V	310 mf 50V	1.5 mf 50V	142	143	Z144	L170	2.5K ±3%	750 ±5%	5.6K ±10%	0.208	4.42K	1.6K	4.7K

*Lambda part no.



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   - LAMBDA PART NO. FBL-00-030; USE IN4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED CIRCUIT BOARD.
   - INDICATES ACTUAL UNIT MARKING.
5. FOR OPERATION AT 47-53Hz OR 63-440Hz, CONSULT FACTORY.
6. ON MODEL LNS-X-5-0V; RI IS 750; R5 IS 750; R9 IS 392; HCI IS ONLY USED ON THIS MODEL.
7. TI PRIMARY CONNECTION SHOWN IS FOR 105-127 VAC INPUT. FOR 210-254 VAC INPUT: DISCONNECT BLK & WHT TRANSFORMER LEADS FROM TERM'S. ACI & AC2 AND RECONNECT BOTH LEADS TO TERM. D.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz. NOMINAL OUTPUT VOLTAGE, NO LOAD, +S AND +V SHORTED, -S AND -V SHORTED. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN -S AND INDICATED POINTS UNLESS OTHERWISE NOTED. VOLTAGES IN PARENTHESIS APPLY TO MODEL LNS-X-5-0V.
9. "J" OPTION UNITS HAVE SINGLE TI PRIMARY. AC INPUT IS 90-110 VAC.

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS..

DOTTED CONNECTIONS SHOWN INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

MODELS
LNS-X-5-0V
LNS-X-6

LAMBDA
ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.

5-Year Guarantee

We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.

We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

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